and lower story with the red windows. From this result by a simple step the coloured bands seen when white light is employed are readily explained. Of course, and wisely so, no attempt is made to explain why with monochromatic light the windows are seen at all. In the same manner most of the phenomena described or which can be observed by following the clear and simple directions are stated to be what they are, rather than proved or explained. The authoress, guided by her own experience as a schoolmistress, is probably right in continually pointing out fresh phenomena of interest, which may or may not be immediately forgotten, rather than in wearying the child with difficult arguments which could at best be imperfectly understood, and which would be sure in many cases to awaken a feeling of disgust. In short, Sunshine is a kindergarten and not a school.

Simple and homely language is employed with the greatest propriety, but occasionally it tends to be vague or even to produce a wrong impression. One or two actual mistakes may be referred to in order that they may be corrected in a future edition.

Thus, it is stated that as a rainbow entirely vanishes when the sun is as much as 42° above the horizon, we can never see one at noon. "In the summer" should obviously be added. The reader is told to spin a top carrying a disk painted half yellow and half blue and he will see green. There is a confusion here between the colour obtained by adding two colours as by spinning, and that which is the result of mixing pigments. As is well known, green is not produced under these circumstances, but white or nearly white. The four chapters on soap bubbles, which contain much that is sure to please, are supplemented by some special instructions, which, however, are not quite correct. Fig. 167 is an illustration of an experiment purporting to measure the surface-tension of a soap bubble by the depression of the water level in a quill tube dipping into a glass of water. As the bubble is drawn much larger than the two hands, the pressure within it would not produce any depression of the water below the general level. It would not even visibly affect the capillary elevation. Then it is stated that the surface-tension of pure water is 16·62 grains per square inch. It is, as a fact, a little over three grains per linear inch. The confusion becomes greater in the passage, "We know exactly how much energy it (the elastic film of water) has—16·62 grains per square inch. A tube of 1-inch bore will lift up 16·62 grains of water."

There is one serious fault in the book. Serious because an experiment is described as though it were being performed to an audience which is not only impracticable and impossible, but which would require in a soap-film a property different in kind to that which it possesses. A school-slate frame with one end removed is hung up so that the remaining end is uppermost. A knitting-needle is cut of such a length that it will slide freely in the groove made to hold the slate. From the knitting-needle a pill-box is hung by threads. The object is to weigh a letter. A soap-film is spread over the frame as far as the knitting-needle.

"See how the film is stretching, the knitting-needle is bringing it down like a blind. Now we place a letter in the balance. I know that it weighs just half an ounce, so I can mark on the slate-frame with my blue pencil the place where the knitting-needle stops for half an ounce. I see I was not mistaken in what would take your fancy! I will hang it up here. You shall make one for yourselves, and spend what time you please with it. You will not then easily forget how elastic the film is."

Now the surface tension of a soap film is so small that if the knitting-needle and pill box weighed nothing the slate frame chosen must have been eight or nine feet across, and the knitting-needle the same length; or if the letter and the pill box weighed nothing the knitting needle, if of steel, must have been a great deal finer than any in ordinary use. But even if the experiment were being performed on a minor planet, instead of at Manchester, where with diminished gravitation the half-ounce knitting-needle and pill box would only just be sufficient to balance the tension of the soap film, the description would give the false impression that like a metal or other spring the tension of the soap film increases as the film is stretched, and so is able to rest steadily at some point which depends on the stretching weight. One obviously invented experiment described with all the circumstance and detail that this is, is sufficient to shake one's faith in the genuineness of other demonstrations.

C. V. B.

STRETTON ON THE LOCOMOTIVE.

The Locomotive Engine and its Development. By Clement E. Stretton, C.E. (London: Crosby Lockwood and Son, 1892.)

THE author of this work is well known to the railway world as one who has long taken a great interest in everything pertaining thereto. No one probably has a better knowledge of the history and development of the locomotive. It is with much pleasure we welcome the volume before us. The author very properly gives to Trevithick the name of "Father of the Locomotive," he having used high-pressure steam, the smooth rail, and the blast pipe, some years before either Hedley or Stephenson began to experiment. It is a pity so many men connected with the early progress of the locomotive should have been lost to fame; all did their share—the few only have been handed down to posterity. William James, for instance, certainly should not be forgotten, he having had a large share of the work in proving the locomotive to be a suitable machine for hauling trains, as against the system of fixed engines and rope haulage, and to him is largely due Stephenson's success on the Liverpool and Manchester Railway.

Richard Trevithick was born April 13, 1771, in the parish of Illogan in Cornwall. He was a mechanical genius in many ways. His first engine was made in the year 1803. This engine ran on four wheels, the boiler was arranged horizontally and had a wrought iron return fire-tube; the cylinder was 8¼ inches in diameter, and the piston had a stroke of 4 feet 6 inches. It was arranged horizontally, the crosshead driving a shaft in front of the boiler by means of a return connecting-rod. This shaft carried a heavy flywheel, and was connected to the carrying wheels of the engine by means of spur gearing. The exhaust steam was discharged into the chimney, ensuring an efficient supply of steam.

In the year 1808 Trevithick laid down a circular railway in a field which now forms the southern half of Euston Square. The locomotive exhibited had a vertical cylinder, the crosshead being coupled direct to the hind pair of wheels. This engine weighed about ten tons, and ran at an approximate speed of ten to twelve miles per hour. From these data it will be at once seen that Trevithick was before either Hedley or Stephenson with the invention of the locomotive engine, since both Hedley's and Stephenson's experiments date from the year 1813.

The volume under notice is full of historical data having reference to these early experiments. The author has taken great pains in arranging the matter. Further on in the book, chapter iii., another most interesting subject is dealt with. "The Battle of the Gauges" will long be remembered by engineers. The standard gauge of railways in this country is 4 feet 8½ inches, measured between the heads of the rails. This peculiar dimension appears to have been originally due to the tramways in use at the collieries where the original experiments were carried out by Stephenson and others, and was adopted for the railways when first projected and locomotives used. The great exception to this standard was the seven-feet gauge of the Great Western Railway. This railway, when projected by Mr. Brunel, was intended to eclipse the narrow-gauge of railways, both in speed and comfort when travelling. This competition, however, is claimed by the author as having been the means of hastening the growth and perfecting the locomotive. Looking at the question from the present day, the 4 feet 8½ inch, or standard gauge, is certainly too narrow; the power of the locomotive has gradually been increasing since Stephenson's day, and a point will soon be reached when radical changes must be made in locomotive design, in order to increase the power still more. On the other hand, the now obsolete seven-feet gauge of Brunel was too large. The Indian engineers have adopted the gauge of 5 feet 6 inches for the standard of that country. This dimension appears to be a "happy mean," and one with which locomotive engineers may revel in large journals and free steam and exhaust ports in locomotives fitted with inside cylinders.

It is amusing to read that American engines commenced their competition with the English engine in the year 1840, when some were imported to work the trains up the Lickey incline of one in thirty-seven on the Birmingham and Gloucester Railway. These engines were made by Messrs. Norris and Co., of Philadelphia, weighing slightly under eleven tons. The author tells us they thoroughly beat the English engine of that day doing this particular service.

Every locomotive engineer knows what the Stephenson link motion is—the apprentice in his first year generally prides himself on having mastered its details; yet, for all this, the author tells us to call this old friend by another name! It seems that this gear is really due to Mr. William Howe, an employé of Messrs. R. Stephenson and Co., and was adopted by them and first fitted to an engine for the North Midland Railway in the year 1842. It may here be noted that the question of valve gear generally is not sufficiently described or illustrated in this volume. The index contains several references, but these are very superficial. This becomes all the more apparent when the Joy valve gear is fully described and illustrated, besides a diagram showing results of working.

The Joy valve gear is in the opinion of many an unsuitable gear for a locomotive. It must be evident that any gear which derives its valve motions principally from the vertical movements of the connecting-rod cannot give a good distribution of steam, for the reason that the vertical movements of the connecting rod are affected by those of the driving-axle. The driving-axle is not always in the same position as regards the frames and cylinders owing to the undulations of the road, the oscillation of the engine, and the varying condition of the springs; a movement of half-an-inch above and below the normal position of the driving-axle is quite within the limits of actual practice. This movement is sufficient to affect the true movement of the valve; indeed, it is enough to destroy the lead either on the front or back ports as the case may be. Besides this objection, the Joy gear has nominally a uniform lead for all degrees of expansion, whereas it is usually considered necessary to increase the lead for higher grades of expansion and speed of engine. Some locomotive engineers are willing to risk this defective steam distribution in order to take advantage of the undoubted improvements in design the adoption of this valve gear allows. These mainly consist in the increase in length of the driving-axle bearings for engines with inside cylinders, there being no eccentrics to find room for between the crank webs. The cylinders can be consequently placed closer together, and the steam chest arranged either above or below the cylinders, as the case may be, without the use of rocking shafts or intermediate gear.

Chapter IV. deals with modern locomotives for main line trains. Many well-known engines are illustrated and described, and we naturally find the Compound Locomotives of Messrs. Worsdell and Webb included in the number. The author evidently is not enamoured with the compound locomotive, saying that "facts" are in favour of the simple engine. It is here to be noted that no locomotive superintendent in this country, excepting the patentees of the respective systems, has adopted the compound system. What this is due to is uncertain, because the two-cylinder type of compound locomotive known as the Worsdell system has certainly given good results in India and other countries, comparing favourably with the simple engine. The "Gladstone" locomotive, designed by the late Mr. William Stroudley, is among those illustrated. This raises the interesting question as to the wisdom of using large leading coupled wheels for express work; many engineers prefer a bogie in front, deeming it safer. But when the London and South Western Railway practically copy Mr. Stroudley's arrangement of wheels in their latest engines for mixed traffic, one is apt to be surprised at the change coming from the "bogie" head quarters, and to surmise that anything will do. There is, however, nothing new in the adoption of large leading coupled wheels; many engines were running in India of this design before Mr. Stroudley adopted it, and the whole question can be narrowed down to the comparative life of tyres under different types of engines; there can be no doubt that a four-wheeled bogie or a Bissel truck in front saves the tyres of the leading coupled wheels, a larger mileage being obtained from them before they require to be returned.

Chapter V. includes a description of the sand blast arrangement for sanding the rails to prevent the slipping of the driving wheels. This apparatus, small as it is, has left its mark on the design of express locomotives. The single engine has again come to the front for express work with marked success, the latest design of Midland and Caledonian engines being examples.

This volume taken as a whole is most interesting, and should be of value to all connected with the railway system of this country as a book of reference.

N. J. LOCKYER.

OUR BOOK SHELF.

Sketches of British Insects. By Rev. W. Houghton, M.A., F.L.S., M.S.L. (London: O. Newmann and Co., 1892.)

IT is satisfactory to find that there is sufficient demand for elementary books on entomology to render necessary a new edition of Mr. Houghton's "Sketches of British Insects;" and for those who, as dwellers in the country, wish to gain some insight into the insect life around them few better books could be found. The differences between the several orders of insects and the main distinctions of the families are plainly and intelligibly set forth, though in a few instances the definition of terms and sections is somewhat faulty; thus, "Arthropod" would be more fitly translated "with jointed feet" instead of "with feet at the joints," and the numerous exceptions are not enough insisted on, there being for instance many insects with aquatic respiration and crustacea with aerial. In Lepidoptera the tongue is often completely absent, whilst in butterflies the forelegs are never wanting, as stated, though in certain families they are rudimentary in both sexes or in the male only, and again the two pairs of spurs on the hind tibiæ are present in the vast majority of moths and also in many skippers. The insects selected for description are well chosen, either as being conspicuous and typical of their families or as illustrating by their peculiarities some principle of adaptation to surroundings, though in many cases the classification is not according to modern ideas; thus, the clearwings (*Sesia*, &c.) have no affinities with the beehawks (*Hemaris*), which belong to the *Sphinges*; and the snouts (*Hypena*) are *Noctues* not *Pyrals*. The account in the Introduction of the structure and metamorphoses is especially simple and clear, and the small volume is on the whole an admirable sketch of British insect life, though the coloration of the plates might have been made much less crude without adding materially to the cost of production.

The Birds of Lancashire. By F. S. Mitchell. Second Edition. Revised and Annotated by Howard Saunders. (London: Gurney and Jackson, 1892.)

WE are glad to welcome a new edition of this book, which we reviewed shortly after the publication of the first edition NATURE, vol. xxxii. p. 241). The task of preparing a new edition (in the absence of Mr. Mitchell from England) was undertaken by Mr. Howard Saunders, and it is scarcely necessary to say that he has discharged his duty thoroughly. He has no personal connection with Lancashire, but he has had much help from local authorities, especially from Mr. R. J. Howard, of Blackburn; and with their aid he has brought the book, as far practicable, up to date. Several species have been added to the list, and there is a new index.

Borneo: Its Geology and Mineral Resources. By Theodor Posewitz. Translated from the German by Frederick H. Hatch. (London: Edward Stanford, 1892.)

THE original work, of which this is a translation, has been reviewed in NATURE (vol. xl. p. 49), so that it is unnecessary now to do more than record the fact that an English rendering of the book has been published. Dr. Hatch has done his work most conscientiously, and the translation is likely to be much appreciated by students of geology and mineralogy, and by all who have any reason for being specially interested in the material resources of Borneo.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

"A New Course of Chemical Instruction."

I AM much interested in the article in NATURE for September 29, entitled "A New Course of Chemical Instruction," especially as the writer, in the criticism of the book in question, whilst thinking that the method there advocated has theoretically more to recommend it than any other, doubts whether practically the time required is not an insurmountable obstacle.

For four years I have been able to teach beginners in Chemistry on a method very closely allied to the one here proposed, that is to say, one in which no experiment is performed without a definite object in view—the final object being the solution of a given problem and no idea being given to the pupil of what the result will be, and I am glad to be able to say that the time required is *not* such a serious drawback as might be supposed, whilst the intense interest aroused and the training in scientific methods of work amply compensate for the slower acquirement of chemical facts.

I have not the advantage of being acquainted with Mr. Castell-Evans' book, so that I am not quite sure how nearly my work would agree with his course, but the fundamental principle is undoubtedly the same, and is the one laid down by Dr. Armstrong in the report of the British Association Committee on Chemical Teaching, where he advocates the teaching of Chemical method rather than Chemical facts.

What generally appals the beginner in Chemistry is the multitude of facts to be remembered; it seems a mere question of memory, and in consequence so dull and uninteresting, that the explosion or "burst up" is the one point to be looked forward to in the lesson. By this new method the pupils themselves are put into the position of discoverers, they know why they are at work, what it is they want to discover, and as one experiment after another adds a new link to the chain of evidence which is solving their problem, their interest grows so rapidly, that I have seen at a demonstration lesson a whole class rise to their feet with excitement when the final touch was being put to the problem which it had taken them three or four lessons to solve. Facts learned with so much interest are not forgotten and form a solid basis which it is true is slowly laid, especially at first, but it is interesting to see how much more quickly and easily later facts are assimilated, each one fitting itself in with the knowledge already acquired, and even when it becomes a ques-